



A new species of grenadier, genus *Macrourus* (Teleostei, Gadiformes, Macrouridae) from the southern hemisphere and a revision of the genus

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Abstract

A new *Macrourus* species from the southern hemisphere is described. It was first recognised from the Ross Sea, Antarctica after specimens sampled during the International Polar Year in 2008 showed significant genetic differences (C01) among those initially identified as *M. whitsoni* (Regan). *M. caml* **sp. nov.** has 8 (rarely 7 or 9) pelvic fin rays, a band (2–3 rows) of small uniform-sized teeth in the lower jaw, lacks an outer row of enlarged teeth in the upper jaw, 30–40 scales in a diagonal row from anal fin origin to lateral line, ventral surface of the head is mostly scaled, except for scaleless areas anterior to the mouth and on the anterior half of the lower jaw. *M. caml* **sp. nov.** is large, reaching at least 890 mm TL and appears to be abundant. Numerous specimens caught by commercial bottom longline vessels fishing in the Ross Sea are held at Museum of New Zealand Te Papa Tongarewa, Wellington New Zealand. All five species of *Macrourus* (*M. berglax*, *M. caml*, *M. carinatus*, *M. holotrachys*, and *M. whitsoni*) are compared and illustrated, based on examination of specimens, and a key to species is provided.

Key words: Fishes, Southern Ocean, Antarctica, taxonomy, distribution, identification key, illustration

Introduction

The development of a longline fishery for Antarctic toothfish (*Dissostichus mawsoni*) in the Ross Sea region and for Patagonian toothfish (*D. eleginoides*) further north by New Zealand fishers from about 1998 onwards resulted in the incidental capture of many slope-dwelling fishes. Numerous bycatch fish specimens were retained by New Zealand Ministry of Fisheries observers on board longline vessels and were later transported to New Zealand and gifted to the Museum of New Zealand Te Papa Tongarewa (Te Papa) where they were identified, registered, preserved, and stored in the fish collection (Roberts & Stewart 2001). Analysis of New Zealand catch data from the Ross Sea bottom longline fishery showed that macrourids, probably mostly *Macrourus* spp., made up most of the bycatch with 10 tonnes (t) reported in 1998 which increased to 480 t in 2005 (Hanchet *et al.* 2008). Identification of Ross Sea *Macrourus* specimens at sea by observers was uncertain with many records of *M. carinatus* (Günther) from early years. A sample of 375 specimens caught in 2002 in the Ross Sea bottom longline fishery frozen on board and later returned to NIWA Wellington were tentatively identified using information from Iwamoto (1990a & b) and included 364 *M. whitsoni*, now known to have included *M. caml* **sp. nov.**, and 11 *M. holotrachys* Günther (Marriott *et al.* 2003).

A biodiversity survey of the Ross Sea area was carried out in 2004 (BioRoss Western Ross Sea Voyage) funded by the New Zealand government. This sampled around the Balleny Islands and northwest Ross Sea at depths of 64–1444 m with gear including epibenthic sled, beam trawl and a large rough-bottom fish trawl. Numerous specimens of what were tentatively identified as *M. whitsoni* were captured and returned to Te Papa. A second Ross Sea biodiversity survey (IPY-CAML Voyage) was completed in 2008 and also sampled numerous specimens of *Mac-*

rouurus. Tissue samples taken from specimens during the 2008 survey and from other IPY voyages were analysed with the mitochondrial DNA barcode marker, cytochrome *c* oxidase I (C01), and results showed that there were four and not three clades among the southern hemisphere *Macrourus* (Smith *et al.*, 2011). Taxonomic investigation confirmed the presence of two sympatric and visually very similar species. This study describes the new species and re-describes the others in the genus.

Method and materials

Material examined during this study was collected from the Ross Sea and environs by researchers aboard the NIWA ship *Tangaroa* during biodiversity surveys in 2004 and 2008 (National Institute of Water and Atmospheric Research Ltd, unpublished data). Numerous specimens were also collected by New Zealand Ministry of Fisheries observers on board longline vessels fishing for Antarctic and Patagonian toothfishes (*Dissostichus mawsoni* and *D. eleginoides*) in the Southern Ocean since 1998. The definition of the Southern Ocean used here includes the southern parts of the Pacific, Indian, and Atlantic Oceans with a southern boundary at the Antarctic continent and a northern boundary at approximately the mean position of the Antarctic Polar Front (Lutjeharms, 1990, figure 1).

Our study specimens are deposited in AMS, BMNH, CAS, CSIRO, MNHN, NMNZ, USNM, and VIMS. The reader is referred to Eschmeyer's (1998) and Eschmeyer & Fricke (2011) Catalog of Fishes for institutional abbreviations and for detailed references and authorities to taxonomic names used. Methods for taking counts and making measurements follow procedures of Gilbert and Hubbs (1916), and Trunov and Konstantinov (1986), slightly modified by Iwamoto (1970) and Iwamoto and Sazonov (1988).

Taxonomic descriptions

Macrourus Bloch 1786

(Adapted from Iwamoto 1990a)

Diagnostic features: Head large, broad, its depth 4.2 to 4.8 in total length; snout rounded to bluntly pointed, with a stout modified tricuspid scale at tip; a strong suborbital ridge that extends posteriorly onto the preopercular and ending in a sharp point. Orbit diameter about one-third of head length. Mouth sub-terminal, jaws extend beyond vertical through mid-orbit; outer gill rakers on first arch absent; branchiostegal rays 6. Teeth small, in moderate to broad bands on premaxilla, sometimes with outer series slightly enlarged, the bands tapering posteriorly and ending well short of rictus; mandibular teeth 1 to about 5 teeth wide at symphysis, narrowing to one row posteriorly and extending to about end of rictus. A serrated spinous ray (second, first ray tiny and stout) in the first dorsal fin; pelvic fin rays usually 8 or 9 (7 to 10). Anus close to anal fin, no light organ; swimbladder shallowly bilobed anteriorly, with 4 retia mirabilia. Body scales with an enlarged median row of spinules flanked by parallel rows of much smaller spinules.

A few key references are provided for each synonymy. Refer to Eschmeyer (1998) and Eschmeyer & Fricke (2011) for further information.

Macrourus berglax Lacepède 1801

Macrourus berglax Lacepède, 1801: 169, 170, Pl. 10 (Fig. 1) (original description, no types known, Greenland, Iceland, North Atlantic). Iwamoto in Cohen *et al.*, 1990: 234–236 (description, key); Trunov & Konstantinov, 1990: 44–54 (description, key, in Russian, English summary).

Diagnosis. Ventral surface of head almost entirely scaleless except for short longitudinal series of small scales on preopercle and occasional isolated scales above angle of mouth and rarely on posterior end of lower jaw. Pelvic fin with 8 (rarely 9) rays. Lower jaw laterally with 2–4 irregular rows of small teeth, reduced to one row at posterior end, and increased to about 5 teeth wide at symphysis. Upper jaw teeth about 4–5 rows wide, the outer series slightly enlarged. Body scales large, 13–17 diagonal rows from anal fin origin to lateral line. Pyloric caeca 14–23.

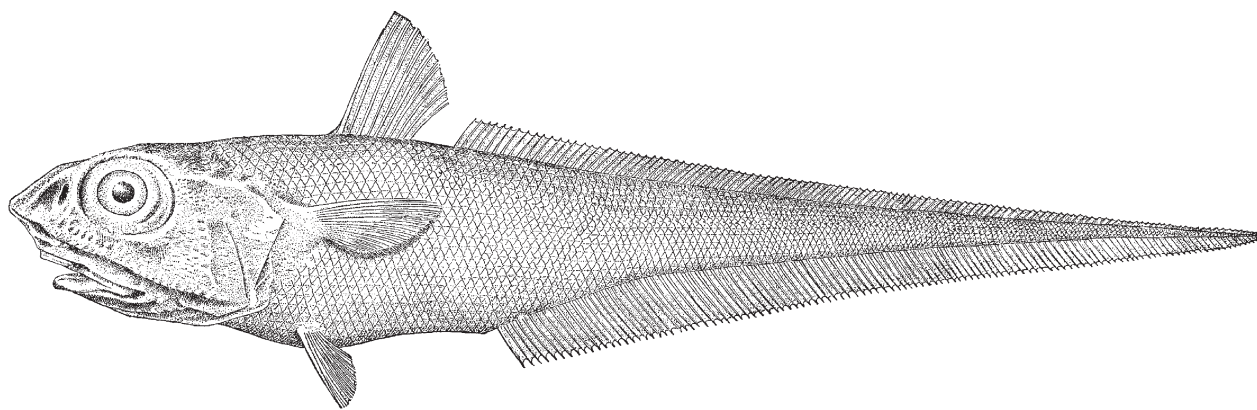


FIGURE 1. *Macrourus berglax*. Drawn by H.L. Todd, after Goode & Bean (1896).

Specimens examined. Non-type specimens (18). **BMNH 1890.11.1.4** (125 mm HL, 580+ mm TL), off Finnmark, Norway, received from Prof. Robert Collett, 1890; **CAS 223416**, ex. VIMS 12893 (4, 91.5–143.5 mm HL, 410–605 mm TL), Bear Seamount, 39° 56' N, 67° 25' W; 1132–1888 m; *Delaware* cruise 200304, sta. 23, 19 May 2003; **ISH 67/55** (67 mm HL, 292+ mm TL), west of Greenland, 63° 13' N, 52° 40' W, 500 m *Anton Dorn* sta. 41/55, 25 Sep. 1955; **ISH 243/63**, (59 mm HL, 261 mm TL), southwest of Barents Is., 73° 33' N, 17° 20' E, *Anton Dorn* sta. 936/63, 410 m; 28 Nov. 1963; **ISH 257/63** (2, 57–58 mm HL, 247–258 mm TL), southeast of Barents Is., 75° 54' N, 21° 17' E, 450–460 m; 29 Nov 1963; **VIMS 12892** (2, 97.3–142 mm HL, 444–615 mm TL), **VIMS 12973** (2, 109.2–144.3 mm HL, 485–613 mm TL), and **VIMS 12987** (2, 92.4–99.6 mm HL, 400–420 mm TL), Bear Seamount, 39° 53' N, 67° 26' W, 1396–1430m, *Delaware* cruise 200304, sta. 26, 20 May 2003; **VIMS 12972** (3, 88.1–102.4 mm HL, 400–480 mm TL), Bear Seamount, 39° 58' N, 67° 27' W, 1946–2022 m; *Delaware* cruise 200304, sta. 32, 22 May 2003.

Counts and measurements (Tables 1–2).

Description (Figure 1, Tables 1–2). A detailed description is not given here because this species is very similar in general form to *Macrourus carinatus* and *M. holotrachys*. The key identifying characters are listed above in the diagnosis and the differences between each species are listed in Comparisons and remarks and Table 3.

Size. Reported to reach more than 910 mm TL (Wheeler 1969), but most commonly 400–800 mm TL, with females attaining much larger sizes than males. In the Barents Sea, specimens larger than 700 mm TL were all females (Dolgov *et al.* 2008:351).

Distribution. Widely distributed in North Atlantic slope waters with temperatures from around 0 to about 4.5° C. Off the North American coasts it occurs from about latitude 37° N, northward to the Labrador Sea and Baffin Bay, and along the east coast of Greenland, north and east to Spitzbergen; in the eastern Atlantic, it is found from the British Isles north into the Norwegian and Barents Seas and into the Arctic slopes (82–83° N) off Spitsbergen. See Iwamoto (1990a, Fig. 535). Depth range recorded is 180 to 2740 m (Wheeler, 1969) but commonly between 200 and 2000 m (Murua 2003; Murua and de Cárdenas 2005).

Comparisons and remarks (Table 3). *Macrourus berglax* and *M. holotrachys* are distinguished from the other three species of *Macrourus* by lacking scales or having only small patches of scales on the underside of the head behind the mouth. *M. berglax* is very similar in morphology to *M. holotrachys*, and the two nominal species appeared similar based on mitochondrial COI sequences (Smith *et al.* 2011). However, our study material showed the following differences for *M. berglax* compared with *M. holotrachys*: scales in a diagonal row from anus to lateral line 13–17 v. 18–26, pyloric caeca 14–23 v. 9–16, pelvic fin rays usually 8 (rarely 9) v. 8–9 respectively (Tables 1 & 2). *Macrourus berglax* is recorded only from the North Atlantic Ocean from about 37° N northward, and *M. holotrachys* is recorded only from the South Atlantic and South Pacific Oceans from about 37° S southward.

Additional mtDNA studies that used the non-coding and potentially faster evolving control region gave results that showed a species specific indel region in all 5 species of *Macrourus*. The shallow sequence divergences among all five species of *Macrourus* likely indicate either recent evolutionary divergence or slow nucleotide substitution at COI in this genus (Smith, unpublished data).

TABLE 1. Summary of counts and measurements for specimens of *Macrourus* examined in this study. Data for holotype or lectotype in boldface. –, no data.

| | <i>M. berglax</i> | <i>M. caml</i> | <i>M. carinatus</i> | <i>M. holotrachys</i> | <i>M. whitsoni</i> |
|-----------------------------|-------------------|---------------------|----------------------|-----------------------|----------------------|
| | N = 18 | N = 62 | N = 46 | N = 30 | N = 46 |
| Total length (mm) | 247–640 | 589 , 83–890 | 523 , 143–815 | 222 , 482–910 | 274 , 256–657 |
| Head length (mm) | 57–144 | 123 , 20–184 | 112 , 30–181 | 51 , 112–207 | 63 , 63–149 |
| Measurements in % HL | | | | | |
| Snout length | 29–37 | 31 , 27–33 | 32 , 26–36 | 35 , 28–34 | 29 , 27–33 |
| Preoral length | 20–29 | 22 , 20–31 | 17 , 13–28 | 31 , 20–27 | 24 , 17–26 |
| Internasal width | 17–20 | 20 , 16–21 | 16 , 14–21 | 20 , 16–21 | 14 , 16–19 |
| Interorbital width | 14–21 | 25 , 20–29 | 18 , 14–19 | 20 , 15–22 | 22 , 20–26 |
| Orbit diameter | 33–39 | 34 , 33–40 | 33 , 32–40 | 37 , 30–40 | 37 , 29–38 |
| Suborbital width | 13–17 | 15 , 11–15 | 14 , 12–16 | 16 , 12–18 | 13 , 12–16 |
| Postorbital length | 30–41 | 39 , 34–42 | 38 , 32–43 | 31 , 33–42 | 37 , 36–43 |
| Orbit to preopercle length | 32–41 | 41 , 36–42 | 40 , 31–42 | 31 , 31–41 | 35 , 37–45 |
| Upper jaw length | 27–39 | 37 , 31–41 | 36 , 27–43 | 28 , 30–40 | 38 , 34–46 |
| Barbel length | 6–16 | 13 , 10–16 | 13 , 11–22 | 6 , 7–20 | 6 , 8–14 |
| First gill slit length | 10–12 | 17 , 11–23 | 12 , 10–13 | 8 , 7–14 | 18 , 16–22 |
| 1D–2D interspace | 8–25 | 27 , 17–35 | 21 , 15–31 | 14 , 13–30 | 22 , 19–43 |
| 1D height | – | 54 , 54–74 | 57 , 46–65 | 49–67 | 53–64 |
| Pectoral length | – | 58 , 48–66 | 49 , 44–55 | 44–58 | 46–58 |
| Pelvic length | – | 55 , 41–58 | 33–49 | 33–43 | 39–62 |
| Counts | | | | | |
| 1D (segmented rays) | 9–12 | 10 , 8–11 | 10 , 8–11 | 9 , 8–11 | 9 , 9–10 |
| Pectoral rays (exc. I) | 16–21 | 18 , 17–20 | 20 , 17–20 | 19 , 17–21 | 19 , 17–21 |
| Pelvic rays | 8–9 | 8 , 7–9 | 8 , 7–9 | 9 , 8–10 | 9 , 9–10 |
| GR-I (mesial) | 8–10 | 11 , 10–13 | 10 , 8–11 | 8 , 8–10 | 12 , 9–14 |
| GR-II (lateral) | 7–10 | 10 , 9–12 | 7–10 | 6–9 | 9–14 |
| GR-II (mesial) | 8–11 | 11 , 10–13 | 12 , 8–11 | 9 , 6–10 | 14 , 10–15 |
| Scales anal fin to lat. ln. | 13–17 | 32 , 30–40 | 19–25 | 18–26 | 34–45 |
| Scales on predors lat. ln. | 26–36 | 27 , 27–36 | 27 , 22–33 | 33 , 24–35 | 33 , 25–36 |
| Scales mid 1D | 5–7 | 7 , 6–8 | 6 , 5–7 | 5 , 5–7 | 7 , 6–9 |
| Scales origin 2D | 6–8 | 7 , 7–9 | 6 , 5–7 | 6 , 5–7 | 8 , 6–10 |
| Pyloric caeca | 14–23 | 20–37 | 13–20 | 11 , 9–16 | 18 , 15–26 |

Macrourus berglax is a commercially important species in the North Atlantic and is taken mainly as by-catch in the deepwater trawl fishery for Greenland halibut (*Reinhardtius hippoglossoides*). Annual catches of the species peaked in 1998 and 1999 at more than 7000 tons, but declined to below 4000 tons between 2001 and 2003.

Macrourus caml sp. nov.

Caml grenadier

Macrourus whitsoni (in part not Regan 1913): Trunov & Konstantinov, 1989: 54–65 (97 specimens, description, compared with *M. carinatus*, in Russian, English summary). Marriott *et al.*, 2003: 39–41 (364 specimens, Ross Dependency).

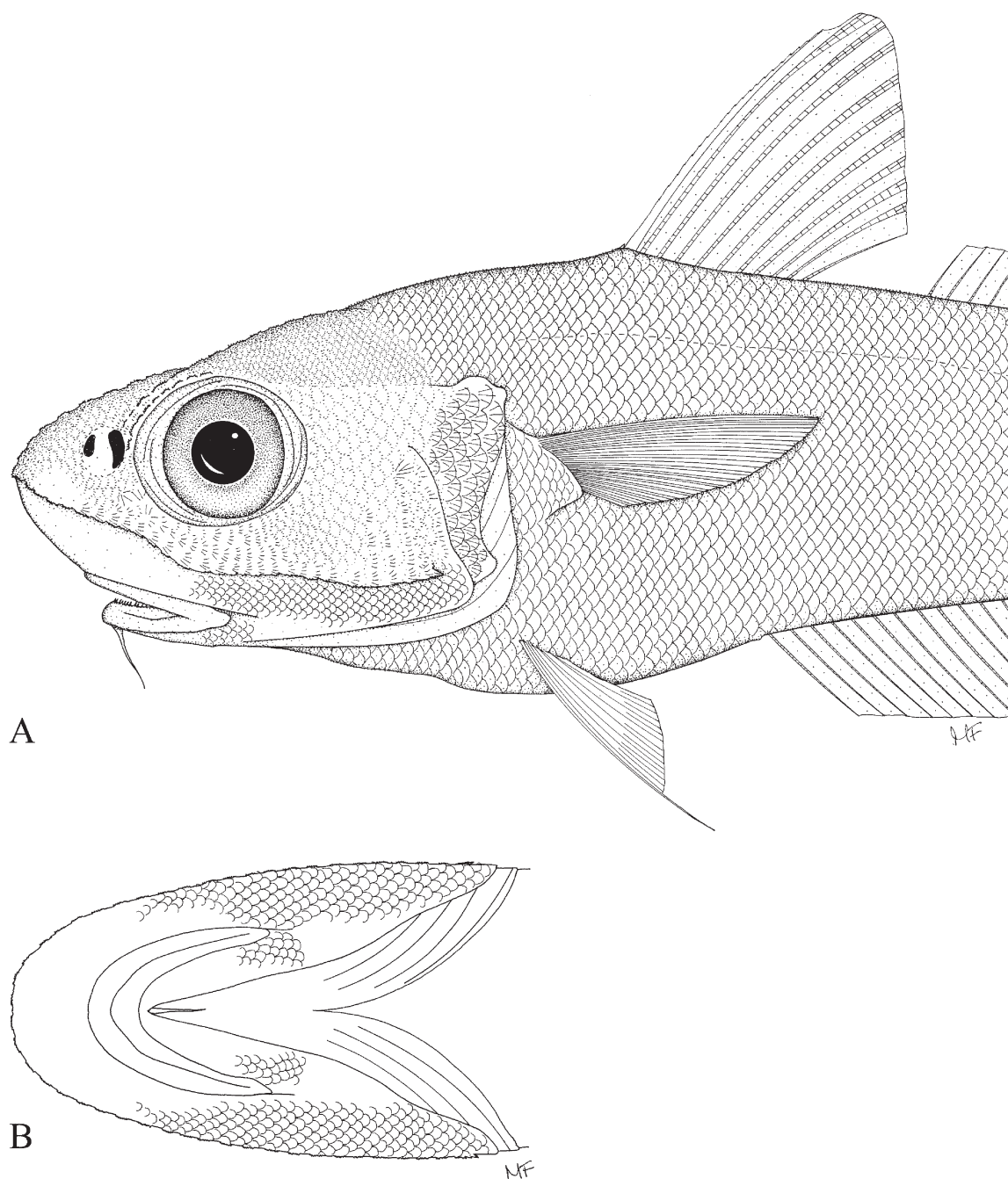


FIGURE 2. *Macrourus caml* sp. nov. Holotype, NMNZ P.043633 (123 mm HL, 589+ mm TL), Ross Sea slope, 72° 20.7' S, 175° 33.3' E, 945–952 m, 21 Feb 2008 (A) Lateral view of head and trunk; (B) ventral view of head and trunk, drawn by Michelle Freeborn (Te Papa).

Diagnosis. Ventral surface of the head mostly scaled, except for scaleless areas anterior to the mouth and on the anterior half of the lower jaw. Pelvic fin with 8 rays, rarely 7 or 9. Lower jaw with 2–3 rows of small pointed uniform-sized teeth reducing to a single row posteriorly. Upper jaw with 4–5 rows of small, uniform-sized teeth. Body scales small, 30–40 in a diagonal row from anal fin origin to lateral line. Pyloric caeca 20–37.

Specimens examined. Holotype. NMNZ P.043633 (123 mm HL, 589+ mm TL), Ross Sea slope, Antarctica, 72° 21' S, 175° 33' E, 945–952 m, RV *Tangaroa*, IPY/CAML TAN 0802/121, bottom trawl, 21 Feb 2008.

Paratypes (33). AMS I.45750-001 ex NMNZ P.037602 (102 mm HL, 456 mm TL), Ross Sea slope, 73° 56' S, 176° 53' W, 838–922 m, FV *Janas*, OBS 1302/126, bottom longline, 21 Feb 2000; BMNH 2011.8.1.1 ex NMNZ P. 9372 (118 mm HL, 577 mm TL), Ross Sea slope, 73° 15' S, 177° 18' W, 940–1211 m, FV *Janas*, OBS 1181/027,

bottom longline, 19 Jan 1999; **CAS 233433** ex NMNZ P.043997 (102 mm HL, 479 mm TL), Ross Sea slope, 73° 15' S, 178° 44' E, 760–770 m, RV *Tangaroa*, IPY/CAML TAN 0802/106, bottom trawl, 19 Feb 2008; **CSIRO H 7251-01** ex NMNZ P.043592 (77 mm HL, 359 mm TL), Ross Sea slope, 73° 15' S, 178° 44' E, 760–770 m, RV *Tangaroa*, IPY/CAML TAN 0802/106, bottom trawl, 19 Feb 2008; **MNHN: 2011-0280** ex NMNZ P.040371 (62 mm HL, 279 mm TL), Balleny Islands, 66° 33' S, 163° 1' E, 550–574 m, RV *Tangaroa*, TAN 0402/249, bottom trawl, 05 Mar 2004; **NMNZ P.036091** (168 mm HL, 767 mm TL), Ross Sea slope, 72° 3' S, 173° 35' E, 885–1038 m, FV *Janas*, OBS 1181/109, bottom longline, 17 Feb 1999; **NMNZ P.036104** (119 mm HL, 580 mm TL), Ross Sea slope, 73° 15' S, 177° 18' W, 940–1211 m, FV *Janas*, OBS 1181/027, bottom longline, 19 Jan 1999; **NMNZ P.036142** (104 mm HL, 380 mm TL), **NMNZ P.036173** (115 mm HL, 425 mm TL), Ross Sea slope, 73° 1' S, 176° 53' E, 863–919 m, FV *San Aotea II*, OBS 1180/004, bottom longline, 14 Jan 1999; **NMNZ P.036174** (84 mm HL, 370 mm TL), Ross Sea slope, 71° 27' S, 178° 40' W, 1020–1111 m, FV *San Aotea II*, OBS 1180/103, bottom longline, 15 Feb 1999; **NMNZ P.036988** (3, 99–103 mm HL, 465–469 mm TL), South Georgia, 54° 0' S, 39° 0' W, 1300–2000 m, Apr 1997; **NMNZ P.037599** (126 mm HL, 485 mm TL), Ross Sea slope, 74° 23' S, 176° 33' W, 896–896 m, FV *Janas*, OBS 1302/144, bottom longline, 26 Feb 2000; **NMNZ P.037602** (2, 103–122 mm HL, 433–542 mm TL), Ross Sea slope, 73° 56' S, 176° 53' W, 838–922 m, FV *Janas*, OBS 1302/126, bottom longline, 21 Feb 2000; **NMNZ P.037603** (99 mm HL, 439 mm TL), Ross Sea slope, 74° 16' S, 176° 53' W, 786–796 m, FV *Janas*, OBS 1302/139, bottom longline, 25 Feb 2000; **NMNZ P.037762** (2, 114–121 mm HL, 536–554 mm TL), Ross Sea slope, 69° 21' S, 178° 39' W, 425–1661 m, FV *Janas*, OBS 1429/122, bottom longline, 20 Feb 2001; **NMNZ P.038635** (131 mm HL, 533 mm TL), Scott Island seamounts, 68° 2' S, 179° 7' W, 1010–1156 m, FV *San Aotea II*, OBS 1595B/138, bottom longline, 18 Apr 2002; **NMNZ P.038793** (184 mm HL, 890 mm TL), Ross Sea slope, 71° 15' S, 176° 36' E, 1440 m, FV *San Aotea II*, OBS 1725/041, bottom longline, 22 Jan 2003; **NMNZ P.040634** (2, 102–112 mm HL, 445–461 mm TL), Ross Sea slope, 71° 31' S, 178° 45' W, 1168–1251 m, FV *Gudni Olafsson*, OBS 1843/075, bottom longline, 10 Feb 2004; **NMNZ P.041446** (132 mm HL, 625 mm TL), Cosmonaut Sea, 66° 19' S, 33° 14' E, 1317–1334 m, FV *Janas*, OBS 2068/033, bottom longline, 26 Mar 2005; **NMNZ P.042222** (147 mm HL, 722 mm TL), Pacific-Antarctic Ridge, 66° 30' S, 176° 23' W, 1660–2080 m, FV *Avro Chieftain*, OBS 2186/006, bottom longline, 22 Dec 2005; **NMNZ P.042353** (128 mm HL, 618 mm TL), Ross Sea slope, 72° 39' S, 179° 35' W, 762–793 m, FV *Sonrisa*, OBS 1311/001, bottom longline, 30 Jan 2000; **NMNZ P.042587** (123 mm HL, 527 mm TL), South Georgia, 54° 39' S, 39° 3' W, 1260 m, , FV *San Aspiring*, OBS 2234/123, bottom longline, 06 Jul 2006; **NMNZ P.042591** (147 mm HL, 720 mm TL), South Georgia, 53° 13' S, 42° 7' W, 1280 m, , FV *San Aspiring*, OBS 2234/236, bottom longline, 27 Aug 2006; **NMNZ P.043591** (87 mm HL, 319 mm TL); **NMNZ P.043683**, (123 mm HL, 598 mm TL), Ross Sea slope, 71° 56' S, 173° 18' E, 1431–1658 m, RV *Tangaroa*, IPY/CAML TAN 0802/144, bottom trawl, 23 Feb 2008; **NMNZ P.043997** (122 mm HL, 573 mm TL), Ross Sea slope, 73° 15' S, 178° 44' E, 760–770 m, RV *Tangaroa*, IPY/CAML TAN 0802/106, bottom trawl, 19 Feb 2008; **NMNZ P.045643** (41 mm HL, 184 mm TL), Scott Island seamounts, 68° 7' S, 179° 15' W, 855–879 m, RV *Tangaroa*, IPY/CAML TAN 0802/211, bottom trawl, 03 Mar 2008; **USNM 402714** ex NMNZ P.040102 (68 mm HL, 321 mm TL), Ross Sea slope, 71° 30' S, 171° 48' E, 540–549 m, RV *Tangaroa*, TAN 0402/172, bottom trawl, 27 Feb 2004.

Non-type specimens (28). **NMNZ P.038623** (115 mm HL, 405 mm TL), Ross Sea slope, 71° 48' S, 177° 26' W, 757–784 m, FV *Janas*, OBS 1593A/034, bottom longline, 26 Jan 2002; **NMNZ P.040263** (10, 38–50 mm HL, 174–236 mm TL), Balleny Islands, 67° 15' S, 164° 51' E, 348–353 m, RV *Tangaroa*, TAN 0402/218, bottom trawl, 03 Mar 2004; **NMNZ P.040322** (7, 26–59 mm HL, 132–274 mm TL), Balleny Islands, 66° 33' S, 163° 1' E, 550–574 m, RV *Tangaroa*, TAN 0402/249, bottom trawl, 05 Mar 2004; **NMNZ P.040370** (80 mm HL, 360 mm TL), Balleny Islands, 66° 41' S, 162° 46' E, 377–383 m, RV *Tangaroa*, TAN 0402/246, bottom trawl, 05 Mar 2004; **NMNZ P.043590** (6, 20–63 mm HL, 108–301 mm TL), Ross Sea slope, 73° 15' S, 178° 44' E, 760–770 m, RV *Tangaroa*, IPY/CAML TAN 0802/106, bottom trawl, 19 Feb 2008; **NMNZ P.043883** (38 mm HL, 170 mm TL), Admiralty seamount, 66° 59' S, 170° 51' E, 445–455 m, RV *Tangaroa*, IPY/CAML TAN 0802/265, bottom trawl, 10 Mar 2008; **NMNZ P.043890** (2, 21–35 mm HL, 83–160 mm TL), Admiralty seamount, 67° 7' S, 170° 56' E, 543–545 m, RV *Tangaroa*, IPY/CAML TAN 0802/279, epibenthic sled, 11 Mar 2008.

Counts and measurements (Tables 1–2).

Description (Figures 2–4, Tables 1–2). Head large, length 3.2 to 5.5 into total length. Moderately strong scutes on head ridges, armed with short spinules. Blunt, slightly rounded snout, length less than orbit diameter, tipped with a prominent scute. Upper jaw about same length as orbit diameter, posterior end of premaxilla below or just behind mid-orbit. Chin barbel about one-third of orbit diameter.



A



B

FIGURE 3. *Macrourus caml* **sp. nov.** Holotype, NMNZ P.043633 (123 mm HL, 589+ mm TL), Ross Sea slope, 72° 20.7' S, 175° 33.3' E, 945–952 m, 21 Feb 2008 (A) Lateral view of head and trunk; (B). body scale between lateral line and first dorsal fin base of paratype BMNH 2011.8.1.1 (ex NMNZ P.009372) (118 mm HL, 577 mm TL), photos of preserved specimens by Peter Marriott (NIWA).

Teeth in both jaws small, pointed, may be slightly curved inwards. Upper jaw teeth in 3–5 rows with outer teeth not noticeably enlarged relative to those of inner rows. Lower jaw closely spaced with 2–4 rows at tip, reducing to 1–2 rows posteriorly, outer teeth not noticeably enlarged.

Origin of pelvic fin slightly in advance of pectoral fin, and both slightly in advance of origin of first dorsal fin. First dorsal height and pectoral fin length relatively large compared to others in genus.

Body scales small, deciduous. Those between lateral line and first dorsal fin base with a central long row of enlarged spinules and 3–4 short rows of small spinules on each side. Lower body scales mostly lack a central row of spinules. Dorsal head covered with adherent scales, except for scaleless area around nostrils that extends dorsally to nasal ridge and ventrally to suborbital ridge. Ventral surface of snout anterior to mouth scaleless. Numerous rows of small flat scales lacking spinules at posterior end of ventral surface of head, extending forward to about level with anterior end of orbit and reducing to 1–2 rows anteriorly. Small scales on rear one-third to half of lower jaw in 1–3 rows.

TABLE 2. Distribution of meristic character counts for 5 species of *Macrourus*, N = sample size.

| Pyloric caeca | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|-----------------------|----|---|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|--|--|--|--|--|--|
| Number | N | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | | | | | | |
| <i>M. berglax</i> | 13 | | | | | 1 | 0 | 2 | 2 | 2 | 2 | 1 | 2 | 1 | 1 | 1 | | | | | | | | | | | | | | | | | | | | |
| <i>M. caml</i> | 25 | | | | | | | | | | | | 2 | 0 | 0 | 0 | 1 | 2 | 2 | 6 | 3 | 1 | 0 | 2 | 4 | 0 | 1 | 0 | 0 | 1 | | | | | | |
| <i>M. carinatus</i> | 18 | | | | 1 | 1 | 0 | 3 | 6 | 2 | 4 | 1 | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>M. holotrachys</i> | 18 | 3 | 3 | 4 | 2 | 2 | 1 | 2 | 1 | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| <i>M. whitsoni</i> | 21 | | | | | | 1 | 0 | 1 | 0 | 6 | 3 | 2 | 4 | 2 | 0 | 0 | 1 | 1 | | | | | | | | | | | | | | | | | |

Pelvic fin rays

| Number | N | 7 | 8 | 9 | 10 |
|-----------------------|----|---|----|----|----|
| <i>M. berglax</i> | 34 | | 33 | 1 | |
| <i>M. caml</i> | 92 | 1 | 85 | 6 | |
| <i>M. carinatus</i> | 91 | 1 | 88 | 2 | |
| <i>M. holotrachys</i> | 60 | | 34 | 25 | 1 |
| <i>M. whitsoni</i> | 78 | | | 77 | 1 |

Scales from anal fin origin to lateral line

| Number | N | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 |
|-----------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| <i>M. berglax</i> | 13 | 2 | 2 | 5 | 2 | 2 | | | | | | | | | |
| <i>M. carinatus</i> | 20 | | | | | | 4 | 2 | 2 | 5 | 2 | 4 | 1 | | |
| <i>M. holotrachys</i> | 28 | | | | | 1 | 3 | 5 | 4 | 3 | 4 | 5 | 2 | 1 | |

| Number | N | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 |
|--------------------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| <i>M. caml</i> | 22 | 1 | 2 | 4 | 2 | 5 | 0 | 4 | 3 | 0 | 0 | 1 | | | | | |
| <i>M. whitsoni</i> | 22 | | | | 1 | 0 | 0 | 2 | 0 | 1 | 3 | 3 | 4 | 1 | 3 | 1 | 3 |

TABLE 3. Comparison of characters for species of *Macrourus*.

| Species | Scales on VSH | Teeth upper jaw | Teeth lower jaw | V. (rarely) | Anal fin to LL | Pyloric caeca |
|-----------------------|----------------------------|------------------------------|----------------------------|-------------|----------------|---------------|
| <i>M. berglax</i> | Mostly naked | 4–5 rows, enlarged outer row | 2–4 rows, small uniform | 8 (9) | 13–17 | 14–23 |
| <i>M. caml</i> | Mostly scaled. Snout naked | 4–5 rows, small uniform | 2–3 rows, small uniform | 8 (7, 9) | 30–40 | 20–37 |
| <i>M. carinatus</i> | Mostly scaled. Snout naked | 3–6 rows, enlarged outer row | 2–5 rows, small uniform | 8 (7, 9) | 19–25 | 13–20 |
| <i>M. holotrachys</i> | Mostly naked | 4–6 rows, small uniform | 2–5 rows, small uniform | 8–9 (10) | 18–26 | 9–16 |
| <i>M. whitsoni</i> | Mostly scaled. Snout naked | 2–5 rows, enlarged outer row | 1 row (2 at tip), enlarged | 9 (10) | 34–45 | 15–26 |

VSH—ventral surface of head. V—pelvic fin rays. Anal fin to LL scales—diagonal row of scales from anal fin origin forward to (not including) lateral line scale.

VSH—ventral surface of head. V—pelvic fin rays. Anal fin to LL scales—diagonal row of scales from anal fin origin forward to (not including) lateral line scale.



FIGURE 4. *Macrourus caml* sp. nov. NMNZ P.043590 (58 mm HL, 262+ mm TL), Ross Sea slope Antarctica, 73° 15.3' S, 178° 44.27' E, 760–770 m, 19 Feb 2008, photo of freshly caught specimen by Peter Marriott (NIWA).

Fresh colour of head and body medium to dark brownish or blackish with smaller specimens paler. Sides of head and trunk of large specimens may have greenish iridescence. Bluish abdominal area below about upper edge of pectoral fin base in smaller individuals, but not obvious in larger ones. Lining of mouth and gill cavity greyish-black. Lips brownish. Ventral snout dark brownish with numerous pale pore openings. Fins brownish in smaller and blackish in larger specimens. Preserved specimens brownish or blackish overall.

Size. To at least 890 mm TL and about 4.4 kg.

Distribution (Figure 5A). Probably widespread in the Southern Ocean including the Ross Sea, Balleny and Scott Islands slope, Cosmonaut Sea (33 E), south of South Georgia (54 S), at 350–2080 m.

Etymology. Named for the Census of Antarctic Marine Life (CAML, pronounced ‘camel’) carried out in International Polar Year (2008). Treated as a noun in apposition to the genus name (International Commission on Zoological Nomenclature, 1999).

Comparisons and remarks (Table 3). Previously confused with *Macrourus whitsoni*. The first author participated in two biodiversity surveys of the Ross Sea (2004 & 2008) but did not recognise the presence of the two species of *Macrourus* during initial sorting of catches. DNA analysis (C01) of tissue samples collected during the 2008 IPY surveys indicated four clades among the Southern Ocean specimens: *M. carinatus*, *M. holotrachys*, *M. whitsoni*, and an undescribed species (Fig 2, Smith *et al.* 2011). Meristic and morphometric examination of Te Papa collection specimens resulted in the conclusion that there were two sympatric species. *M. whitsoni* has more pelvic fin rays (9, rarely 10), usually a single row (may be 2 rows at tip) of long, spaced, teeth in the lower jaw, upper jaw with 3–5 rows of teeth with outer row slightly enlarged relative to inner rows, 15–26 pyloric caeca. *M. carinatus* has larger body scales with 19–25 in a diagonal row from anal fin origin to lateral line, fewer pyloric caeca 13–20, and upper jaw has an outer row of slightly enlarged teeth. *M. berglax* from the northern hemisphere and *M. holotrachys* from the southern hemisphere usually have an almost scaleless ventral surface of the head.

Trunov and Konstantinov (1989) reported numerous specimens of what they identified as *Macrourus whitsoni* from the Southern Ocean. But it is very likely that their material included both *M. caml* and *M. whitsoni* because their reported counts of pelvic fin rays, pyloric caeca, and scales from anal fin origin to lateral line mostly straddle the counts made by us for the two separate species (Table 4).

Macrourus caml appears to be abundant in the Ross Sea region and there are numerous specimens of the new species in the Te Papa collection. Many were collected by observers from bottom longline vessels fishing for Antarctic and Patagonian toothfish. Both *M. caml* and *M. whitsoni* appear to readily take baited hooks and are a substantial part of the fishery bycatch (Hanchet *et al.* 2008). Both species have been taken on the same bottom longline set and appear to occupy similar depths although *M. whitsoni* appears to extend to slightly greater depths. The slightly smaller and more subterminal mouth of *M. caml* suggests a more benthic diet compared to *M. whitsoni* which has a slightly larger gape, more terminal mouth and longer teeth. The method of capture (bottom longline and trawl) usually results in the expansion of the gas (swim) bladder and an everted stomach, making feeding study difficult.

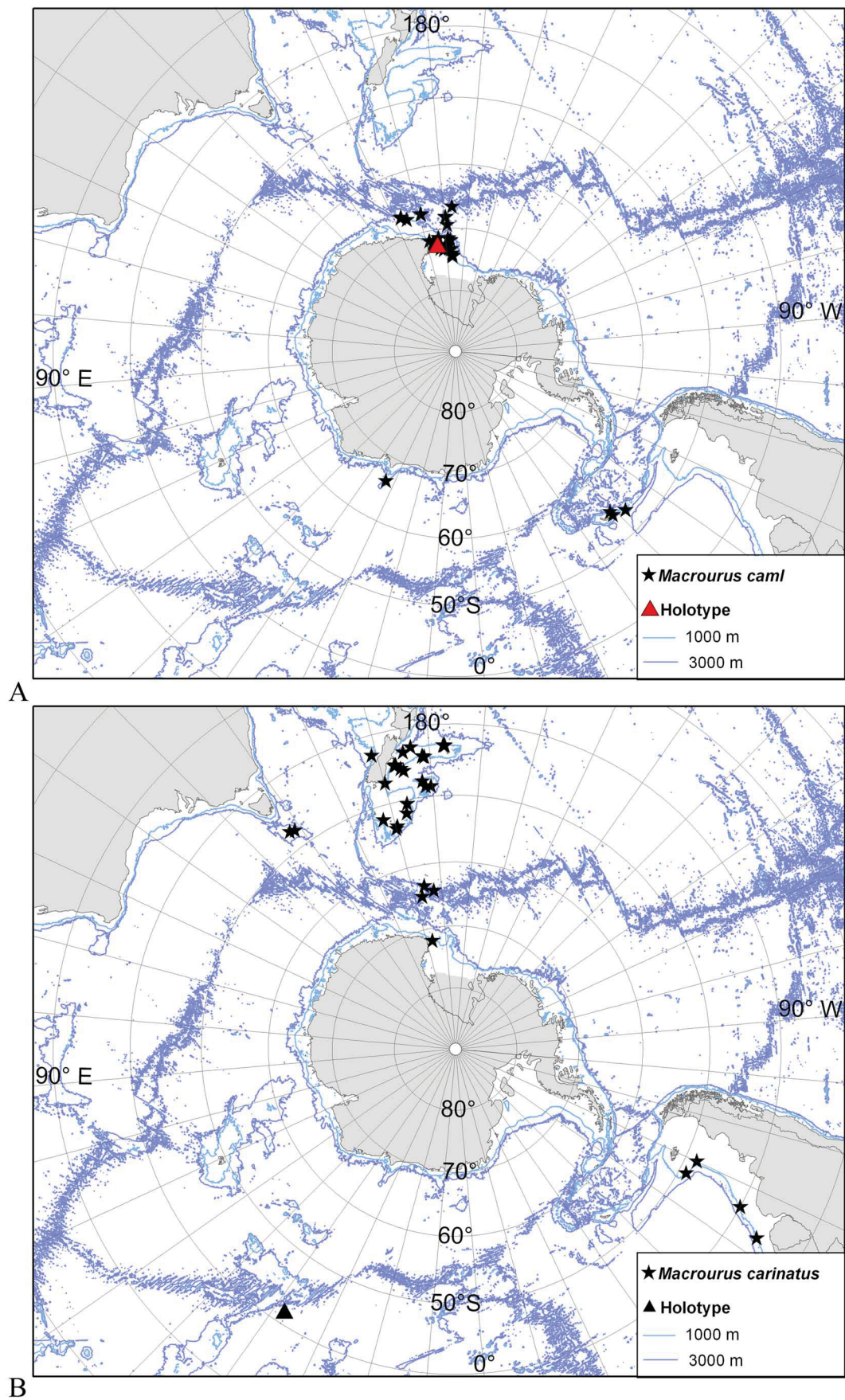


FIGURE 5. Distribution maps for southern hemisphere species of *Macrourus* based only on specimens examined in this study. (A) *M. caml* sp. nov.; (B) *M. carinatus*; (C) *M. holotrachys*; (D) *M. whitsoni*.

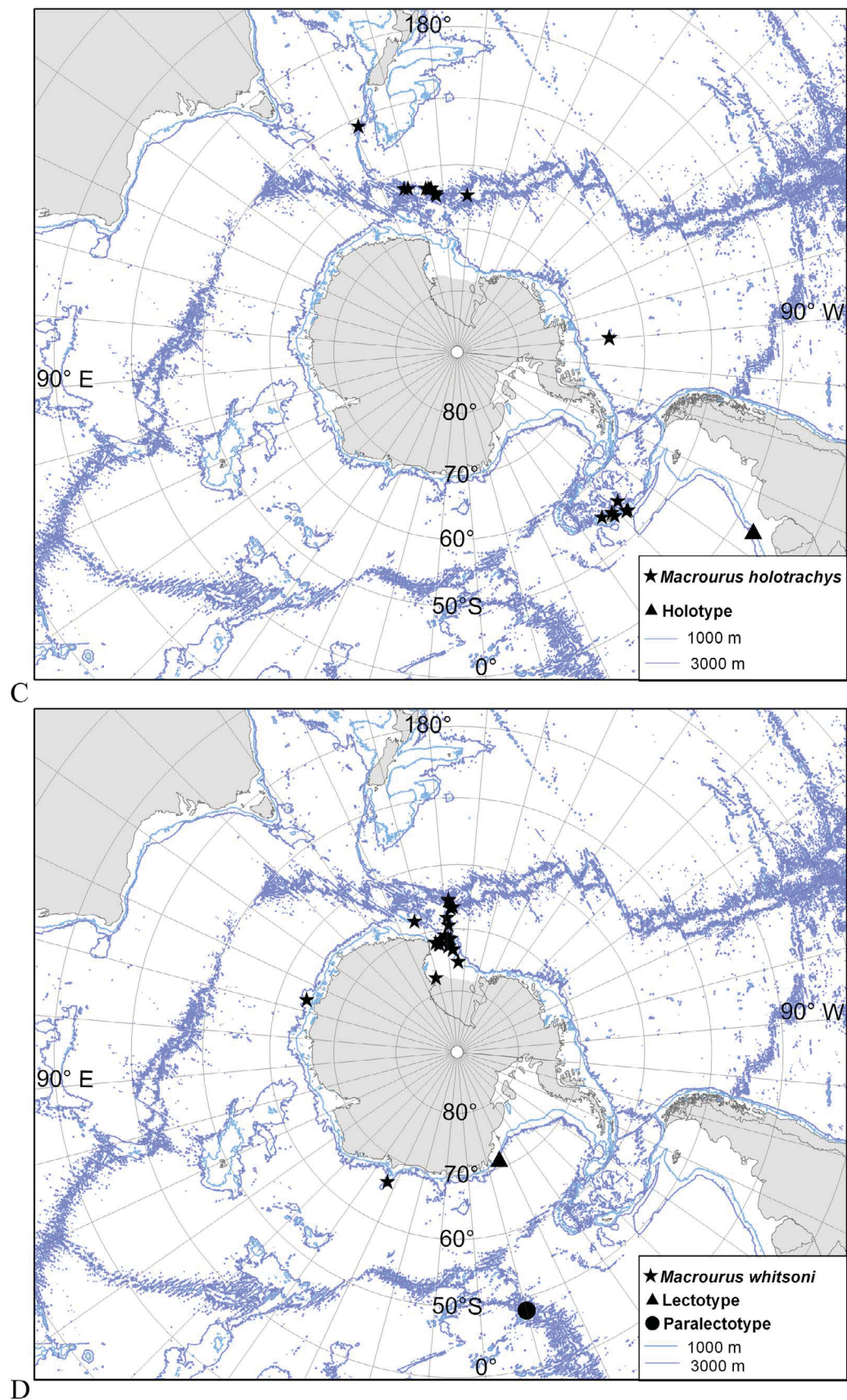


FIGURE 5. Distribution maps for southern hemisphere species of *Macrourus* based only on specimens examined in this study. (A) *M. caml* **sp. nov.**; (B) *M. carinatus*; (C) *M. holotrachys*; (D) *M. whitsoni*.

TABLE 4. Comparison of counts reported for *Macrourus carinatus* and *M. whitsoni* by Trunov & Konstantinov (1989) (T & K, 1989) with those made by us (†) for *M. caml*, *M. carinatus* and *M. whitsoni*. V, pelvic fin rays; P.C, pyloric caeca; Sc. An-LL, scales from anal fin origin to lateral line.

| | <i>M. whitsoni</i> (T & K, 1989) | <i>M. caml</i> † | <i>M. whitsoni</i> † | <i>M. carinatus</i> (T & K, 1989) | <i>M. carinatus</i> † |
|-----------|-------------------------------------|-------------------|----------------------|--------------------------------------|-----------------------|
| V | 7–9 | 8 (rarely 7 or 9) | 9 (rarely 10) | 7–9 | 8 (rarely 7 or 9) |
| P.C. | 15–38 | 20–37 | 15–26 | 11–21 | 13–20 |
| Sc. An-LL | 28–39 | 30–40 | 34–45 | 18–26 | 19–25 |

Macrourus carinatus (Günther 1878)

Coryphaenoides carinatus Günther, 1878: 28. Holotype BMNH 1887.12.7.89, near Prince Edward Island, Challenger station 145A, 310 fathoms [567 m].

Macrurus carinatus—Günther, 1887: 137, Pl. 33 (redescribed, illustrated).

Macrourus carinatus—Trunov & Konstantinov, 1986: 125–135 (described, illustrated, compared with *M. holotrachys*, in Russian, English summary). Trunov & Konstantinov, 1989: 54–65 (108 specimens, description, in Russian, English summary). Trunov & Konstantinov, 1990: 44–54 (described, illustrated, key, in Russian, English summary). Iwamoto in Cohen *et al.*, 1990: 233–240 (described, illustrated, key). Iwamoto in Gon & Heemstra, 1990: 192, 202–206 (described, illustrated, key).

Diagnosis. Ventral surface of the head mostly scaled, except for scaleless areas anterior to the rear angles of the mouth and on the anterior half of the lower jaw. Pelvic fin with 8 rays, rarely 7 or 9. Lower jaw with 2–5 rows of small uniform-sized teeth reducing to a single row posteriorly. Upper jaw with 3–6 rows of teeth with outer row enlarged relative to those of inner rows. Body scales large, 19–25 in a diagonal row from anal fin origin to lateral line. Pyloric caeca 13–20.

Specimens examined. Holotype. **BMNH 1887.12.7.89** (111 mm HL, 515 mm TL); near Prince Edward Is., southeast Indian Ocean, 41° 46' S, 38° 10' E, 310 fm (567 m), *Challenger* stn. 145A (dredge), 27 Dec. 1873. Non-type specimens (45). **ISH 243/71** (37 mm HL, 173 mm TL), south Atlantic, 48° 54' S, 56° 52' W, 830 m, *Walter Herwig* stn. 295/71, 14 Feb 1971; **ISH 1127/6** (3, 85–108 mm HL, 375–395+ mm TL) & **ISH 1127/7** (140 mm HL, 630 mm TL), southeast Atlantic, 36° 0' S, 52° 57' W, 800 m, *Walter Herwig* stn. 237/66; **ISH 1216/66** (106 mm HL, 480+ mm TL), southeast Atlantic Ocean, 39° 59' S, 56° 6' W, 300 m, *Walter Herwig* stn. 264/66; **ISH 1357/66** (4, 71–94 mm HL, 302+–420+ mm TL), southeast Atlantic, 48° 16' S, 60° 12' W, 400 m, *Walter Herwig* stn. 317/66, 26 Jun 1966; **NMNZ P.006647** (142 mm HL, 610+ mm TL), Chatham Rise, NZ, 43° 11' S, 174° 59' E, 298–422 m, RV *Shinkai Maru*, SM 7501/1-2, bottom trawl, 23 Jun 1975; **NMNZ P.006890** (157 mm HL, 716 mm TL), Bounty Platform, NZ, 48° 28' S, 179° 46' E, 565–582 m, RV *Shinkai Maru*, SM 7603/095, bottom trawl, 26 May 1976; **NMNZ P.007004** (139 mm HL, 628 mm TL), Campbell Plateau, NZ, 46° 55' S, 170° 15' E, 960 m, RV *Shinkai Maru*, SM 7603/390, bottom trawl, 18 Sep 1976; **NMNZ P.007561** (140 mm HL, 623 mm TL), Campbell Plateau, NZ, 50° 31' S, 173° 53' E, 772 m, RV *Kaiyo Maru*, KM 78/69/028, bottom trawl, 19 Jan 1978; **NMNZ P.008401** (2, 174–181 mm HL, 813–814 mm TL), Chatham Rise, NZ, 42° 50' S, 176° 58' W, 892–907 m, RV *Wesermünde*, WES 7903/044, bottom trawl, 03 Jun 1979; **NMNZ P.009486** (64 mm HL, 272 mm TL), East of South Is., NZ, 44° 48' S, 173° 11' E, 950–1100 m, FV *Ahktuba*, 14 Nov 1979; **NMNZ P.011285** (140 mm HL, 582+ mm TL), Northeast North Is. NZ, 34° 44' S, 174° 28' E, 745–750 m, FV *Kalinovo*, K 8101/008, bottom trawl, 21 Nov 1981; **NMNZ P.011292** (144 mm HL, 676 mm TL), Chatham Rise, NZ, 44° 6' S, 178° 31' E, 930–975 m, FV *Kalinovo*, K 8101/116, bottom trawl, 12 Dec 1981; **NMNZ P.011434** (53 mm HL, 246 mm TL), Chatham Rise, NZ, 44° 13' S, 178° 58' E, 1005–1030 m, FV *Kalinovo*, K 8101/083, bottom trawl, 06 Dec 1981; **12115** (161 mm HL, 742 mm TL), Campbell Plateau, NZ, 51° 52' S, 173° 23' E, 646–651 m, RV *Shinkai Maru*, SM 82/--/173, bottom trawl, 19 Apr 1982; **NMNZ P.012116** (2, 165–174 mm HL, 704–793 mm TL), Campbell Plateau, NZ, 53° 26' S, 170° 32' E, 631–644 m, RV *Shinkai Maru*, SM 82/--/154, bottom trawl, 13 Apr 1982; **12930** (146 mm HL, 625 mm TL), Chatham Rise, NZ, 42° 38' S, 176° 36' E, 1135–1140 m, FV *Kaltan*, KTN 8201/145, bottom trawl, 27 Aug 1982; **NMNZ P.014769** (124 mm HL, 512 mm TL), Challenger Plateau, NZ, 42° 39' S, 169° 8' E, 1029–1125 m, FV *Arrow*, ARR 8303/018, bottom trawl, 15 Oct 1983; **NMNZ P.014880** (158 mm HL, 721 mm TL), East of South Is., NZ, 44° 45' S, 173° 6' E, 902–922 m, RV *James Cook*, JCO 8315/017, bottom trawl, 27 Nov 1983; **NMNZ**

P.015831 (30 mm HL, 143 mm TL), east of South Is., NZ, 44° 50' S, 172° 49' E, 1180–1184 m, RV *James Cook*, JCO 8410/009, bottom trawl, 09 Jun 1984; **NMNZ P.021709** (109 mm HL, 482 mm TL), Bounty Platform, NZ, 48° 25' S, 178° 36' E, 734–741 m, RV *Shinkai Maru*, SM 8202/209, bottom trawl, 28 Apr 1982; **NMNZ P.021710** (107 mm HL, 445 mm TL), Chatham Rise, NZ, 42° 47' S, 177° 17' W, 906–914 m, RV *Wesermünde*, WES 8001/003, , 10 Jul 1980; **NMNZ P.021711** (117 mm HL, 543 mm TL), Chatham Rise, NZ, 42° 50' S, 177° 10' W, 917–978 m, RV *Wesermünde*, WES 8001/112, bottom trawl, 10 Aug 1980; **NMNZ P.023014** (35 mm HL, 166 mm TL), east of South Is., NZ, 44° 50' S, 172° 49' E, 1180–1184 m, RV *James Cook*, JCO 8410/009, bottom trawl, 09 Jun 1984; **NMNZ P.023500** (90 mm HL, 381 mm TL), Campbell Rise, NZ, 53° 45' S, 170° 4' E, 875–875, RV *Wesermünde*, WES 7902B/139, bottom trawl, 13 May 1979; **NMNZ P.024200** (120 mm HL, 501 mm TL), South Tasman Rise, 47° 12' S, 147° 48' E, 1024–1056 m, FV *Amaltal Explorer*, OBS 0314/015, bottom trawl, 12 Jan 1989; **NMNZ P.026961** (2, 144–155 mm HL, 620–707 mm TL), Campbell Plateau, NZ, 51° 58' S, 167° 39' E, 774–781 m, FV *Amaltal Explorer*, AEX 9002/042, bottom trawl, 14 Nov 1990; **NMNZ P.026991** (137 mm HL, 622 mm TL), Bounty Platform, NZ, 47° 37' S, 178° 1' E, 840–846 m, FV *Amaltal Explorer*, AEX 9002/155, bottom trawl, 09 Dec 1990; **34622** (76 mm HL, 332 mm TL), Chatham Rise, NZ, 45° 24' S, 173° 59' E, 1373–1373 m, RV *Tangaroa*, NZOI S0154, 7 Oct 1979; **NMNZ P.034730** (104 mm HL, 446 mm TL), Chatham Rise, NZ, 45° 46' S, 174° 31' E, 1586–1586 m, RV *Tangaroa*, NZOI S0151, Oct 1979; **NMNZ P.035714** (141 mm HL, 625 mm TL), South Tasman Rise, 47° 28' S, 148° 48' E, 874–898 m, FV *Arrow*, OBS 1137/005, bottom trawl, 07 Aug 1998; **NMNZ P.038558** (144 mm HL, 672 mm TL), Pacific Antarctic Ridge, 63° 9' S, 174° 14' E, 866–1241 m, FV *San Aotea II*, OBS 1595B/171A, bottom longline, 05 May 2002; **NMNZ P.040601** (2, 174–177 mm HL, 805–815 mm TL), Pacific Antarctic Ridge, 64° 44' S, 172° 50' E, 1114 m, FV *Avro Chieftain*, OBS 1742/090, bottom longline, 08 Apr 2003; **NMNZ P.042354** (133 mm HL, 572 mm TL), Pacific Antarctic Ridge, 64° 6' S, 177° 20' E, 1508–1543 m, FV *Janas*, OBS 1593B/226, bottom longline, 23 May 2002; **NMNZ P.042655** (154 mm HL, 682 mm TL), Ross Sea, 71° 52' S, 173° 9' E, 1004–1038 m, FV *Avro Chieftain*, OBS 2330/039, bottom longline, 10 Jan 2007; **NMNZ P.042961** (45 mm HL, 218 mm TL), Chatham Ridge, NZ, 44° 6' S, 178° 38' E, 1010–1025 m, FV *Kalinovo*, K 8101/078, bottom trawl, 05 Dec 1981.

Counts and measurements (Tables 1–2).

Description (Figures 6–7, Tables 1–2). Head large, length 4.1 to 4.8 into total length. Scutes on head ridges armed with short spinules. Short snout, length less than orbit diameter, tipped with a moderate scute. Prominent scutes on angles of snout where nasal ridge meets suborbital ridge. Mouth close to snout tip, with upper jaw about same length as orbit diameter, posterior end of premaxilla below about mid-orbit. Chin barbel about one-third of orbit diameter.

Upper jaw teeth in 5–6 rows with outer teeth noticeably enlarged relative to those of inner rows. Lower jaw teeth with about 3 rows at tip, reducing to 1–2 posteriorly, outer teeth not noticeably enlarged.

Origins of pectoral and pelvic fins about on same vertical, and both slightly in advance of origin of first dorsal fin.

Body scales large, moderately thick, deciduous. Those between lateral line and first dorsal fin base with a long central row of enlarged spinules with 4–5 short lateral ridges of smaller spinules. Dorsal head covered with spinulated, adherent scales, except for scaleless area around nostrils extending dorsally to nasal ridge and ventrally to suborbital ridge. Ventral surface of head anterior to the rear angles of the mouth scaleless. Numerous rows of small embedded flat scales lacking spinules at posterior end of ventral surface of head, extending forward to about mid-orbit and reducing to a few rows anteriorly. Small scales on about rear one-third to half of lower jaw.

Fresh colour of head and body pale greyish-brown with slight greenish iridescent sheen on sides of head and trunk. No obvious dark abdominal area in large individuals. Lining of mouth greyish and gill cavity blackish. Ventral surface of head greyish-brown. Fins greyish-brown. Small individuals have white-tipped dorsal fin and darker middle half of fin. Preserved specimens pale brownish overall.

Size. To at least 815 mm TL.

Distribution (Figure 5B). Widespread in temperate to Subantarctic waters of the southern hemisphere and northern Southern Ocean including South Atlantic Ocean off east coast of South America, southern Africa (Iwamoto & Anderson, 1994), south Indian Ocean including Crozet and Kerguelen Islands (Duhamel, 1997), Prince Edward Island, southern Australia, South Tasman Rise, South Pacific Ocean (New Zealand, Pacific-Antarctic Ridge), at 300–1600 m. One large specimen (NMNZ P.042655) captured on a longline in the Ross Sea is the first verified specimen of the species from the Ross Sea. The capture data for the specimen was checked against

observer records and a photograph of the freshly captured specimen is evidence that the record is genuine. The presence of only a single *Macrourus carinatus* specimen amongst the numerous *M. caml* and *M. whitsoni* specimens collected from the Ross Sea by New Zealand observers suggests that this record is unusual.

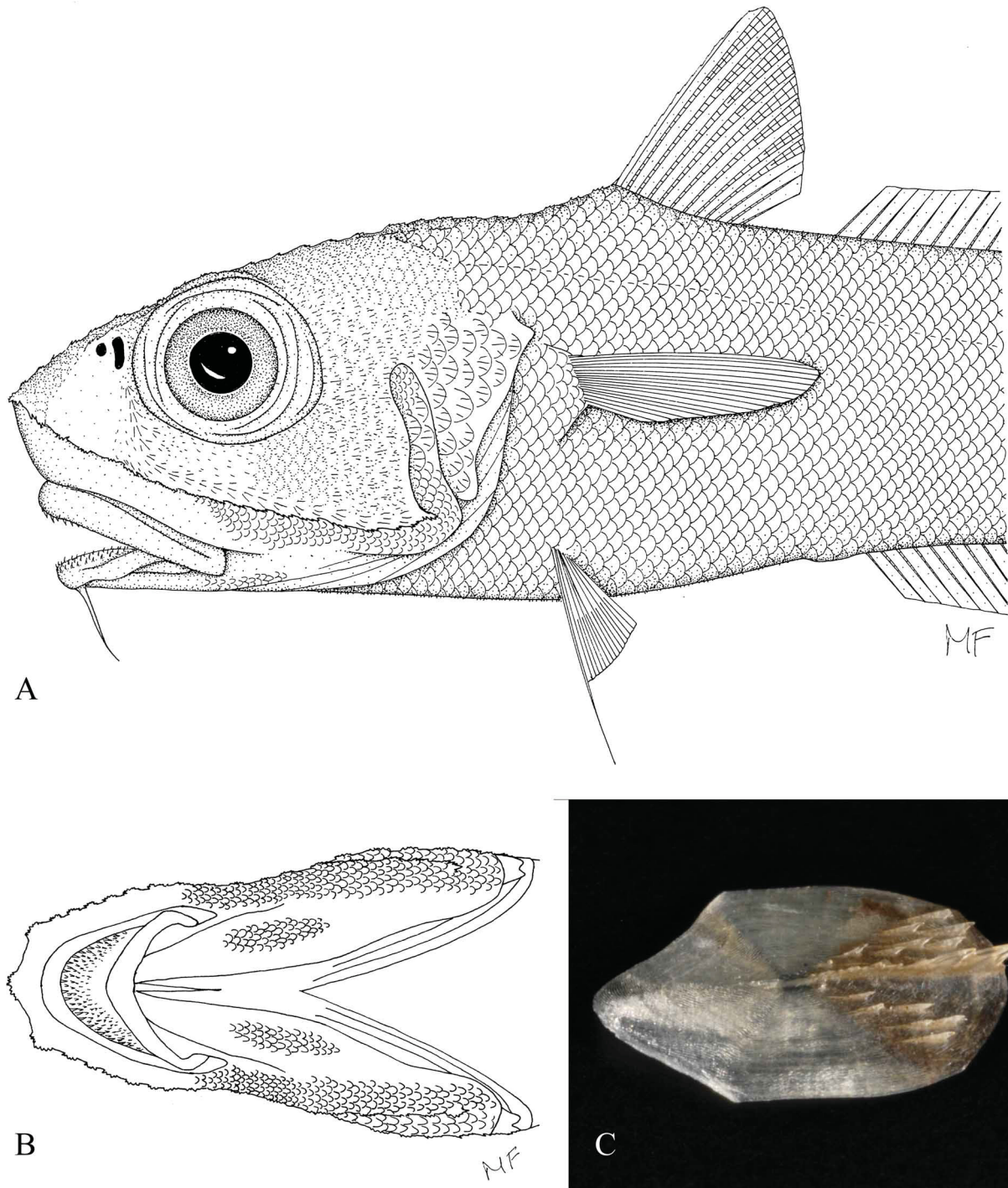


FIGURE 6. *Macrourus carinatus*. NMNZ P.021711 (117 mm HL, 543 mm TL), New Zealand slope 42° 49.6' S, 177° 10.1' W, 917–978 m, 10 Aug. 1980. (A) Lateral view of head and trunk; (B) ventral view of head and trunk, drawn by Michelle Freeborn (Te Papa); (C) photo of body scale between lateral line and first dorsal fin base by Peter Marriott (NIWA).

Comparisons and remarks (Table 3). *Macrourus caml* and *M. whitsoni* also have a mostly scaled ventral surface of the head but *M. caml* has smaller body scales, 30–40 in a diagonal row from anal fin origin to lateral line, more pyloric caeca 20–37, and is much darker, often blackish-brown body and head in large individuals. *M. whitsoni* has small body scales, 36–45 in a diagonal row from anal fin origin to lateral line, and 9 pelvic fin rays. *M.*

holotrachys has a mostly scaleless ventral surface of the head, and a much more robust squamation with thick, adherent body scales armed with a strong central spinule row.

Trunov and Konstantinov (1989) examined numerous specimens of *Macrourus carinatus* and their counts of pelvic fin rays, pyloric caeca, and scales from anal fin origin to lateral line agree closely with our counts for the same species (Table 4). *Macrourus carinatus* is probably the most commonly captured species in the genus in the southern hemisphere, although accurate records of its capture are uncertain because of likely confusion with other species in the genus. It also appears to have a more northern range than the other three southern hemisphere *Macrourus* species.



FIGURE 7. *Macrourus carinatus*. Specimen not retained (about 110 mm HL, 540 mm TL), New Zealand slope, 44° 20.35' S, 178° 59.88' W, 748–755 m, 8 Jan. 2007, photo of freshly caught specimen by Peter Marriott (NIWA).

Macrourus holotrachys Günther 1878

Macrurus holotrachys Günther, 1878: 24. Holotype BMNH 1887.12.7.87, East of Rio de la Plata mouth, Challenger station 320, 600 fathoms [1097 m]. Günther, 1887: 136, Pl. 26 (redescribed, illustrated).

Macrourus holotrachys—Trunov, 1986: 22, 29–31 (described, in Russian, English summary). Trunov & Konstantinov, 1986: 125–135 (described, illustrated, compared with *M. carinatus*, in Russian, English summary). Trunov & Konstantinov, 1990: 44–54 (described, illustrated, key, in Russian, English summary). Iwamoto in Cohen *et al.*, 1990: 233–240 (described, illustrated, key). Iwamoto in Gon & Heemstra, 1990: 192, 202–206 (described, illustrated, key).

Diagnosis. Ventral surface of the head entirely or mostly scaleless but up to 8 small patches of scales (usually less than about 10 small scales per patch) may be present at the posterior end of head, beside articulation of lower jaw and beside posterior end of premaxilla, and rarely posteriorly on lower jaw. Pelvic fin with 8 or 9 rays (rarely 10). Lower jaw with 2–5 rows of small uniform-sized teeth reducing to 1 or 2 rows posteriorly. Upper jaw with 4–6 rows of small, uniform-sized teeth. Body scales large, thick, adherent, with a central row of strong spinules, 18–26 scales in a diagonal row from anal fin origin to lateral line. Pyloric caeca 9–16.

Specimens examined. Holotype. **BMNH 1887.12.7.87** (50 mm HL, 220 mm TL), south east Atlantic Ocean east of Rio de la Plata, 37° 17' S, 53° 52' W, 600 fm (1097 m), *Challenger* stn. 320, 14 Feb 1876.

Non-type specimens (29, all taken by bottom longline). **NMNZ P.036987** (143 mm HL, 640 mm TL), South Georgia, 54° 0' S, 39° 0' W, 1300–2000 m, Apr 1997; **NMNZ P.038550** (153 mm HL, 681 mm TL), **NMNZ P.038555** (185 mm HL, 802 mm TL), Pacific-Antarctic Ridge, 64° 6' S, 177° 20' E, 1508–1543 m, FV *Janas*, Obs 1593b/226, 23 May 2002; **NMNZ P.038556** (186 mm HL, 761+ mm TL), Pacific-Antarctic Ridge, 63° 16' S, 176° 7' E, 1195–1404 m, FV *San Aotea II*, Obs 1595b/168b, 03 May 2002; **NMNZ P.038572** (2, 150–183 mm HL, 612–790 mm TL), Pacific-Antarctic Ridge, 63° 11' S, 174° 19' E, 1084–1224, FV *San Aotea II*, Obs 1595b/170A, 04 May 2002; **NMNZ P.038573** (2, 132–203 mm HL, 557–817+ mm TL), Pacific-Antarctic Ridge, 63° 16' S, 175° 5' E, 1368–1383 m, FV *San Aotea II*, Obs 1595b/169A, 03 May 2002; **NMNZ P.038598** (165 mm HL, 682 mm TL), Pacific-Antarctic Ridge, 63° 22' S, 175° 33' E, 1163–1166 m, FV *Janas*, Obs 1593b/228, 26 May 2002; **NMNZ P.039922** (166 mm HL, 600+ mm TL), Pacific-Antarctic Ridge, 64° 34' S, 171° 11' W, 1278–1463 m, FV *Avro Chieftain*, Obs 1841/018, 14 Dec 2003; **39949** (146 mm HL, 600 mm TL), **NMNZ P.039957** (139 mm HL, 611 mm TL) Macqua-

rie Ridge, 51° 8' S, 161° 29' E, 853–1364 m, FV *San Aotea II*, Obs 1836/005, 12 Nov 2003; NMNZ P.040586 (207 mm HL, 910 mm TL), Pacific-Antarctic Ridge, 64° 28' S, 177° 32' E, 1100–1455 m, FV *Avro Chieftain*, Obs 1742/097, 14 Apr 2003; NMNZ P.041359 (152 mm HL, 665 mm TL), NMNZ P.041360 (162 mm HL, 763 mm TL), De Gerlache Seamount, 65° 19' S, 90° 37' W, 1233–1407 m, FV *Avro Chieftain*, Obs 2009/084, 14 Feb 2005; NMNZ P.041361 (162 mm HL, 696 mm TL), De Gerlache Seamount, 65° 19' S, 90° 25' W, 1055–1340 m, FV *Avro Chieftain*, Obs 2009/087, 15 Feb 2005; NMNZ P.042247 (147 mm HL, 599+ mm TL), Pacific-Antarctic Ridge, 62° 22' S, 167° 6' E, 1365–1386 m, FV *San Aotea II*, Obs 2184/123, 15 Feb 2006; NMNZ P.042248 2, 167–187 mm HL, 749–835 mm TL), Pacific-Antarctic Ridge, 62° 31' S, 168° 28' E, 1180–1241 m, FV *San Aotea II*, Obs 2184/120, 13 Feb 2006; NMNZ P.042573 (162 mm HL, 715 mm TL), NMNZ P.042574 (145 mm HL, 632+ mm TL), NMNZ P.042575 (2, 130–153 mm HL) West of South Georgia, 53° 16' S, 41° 55' W, 1200 m, FV *San Aspiring*, Obs 2234/235, 28 Aug 2006; NMNZ P.042585 (113 mm HL, 494+ mm TL), NMNZ P.042586 (144 mm HL, 641 mm TL) South Georgia, 54° 39' S, 39° 3' W, 1260 m, FV *San Aspiring*, Obs 2234/123, 06 Jul 2006; NMNZ P.042588 (144 mm HL, 611+ mm TL), South Georgia, 55° 10' S, 36° 22' W, 1250 m, FV *San Aspiring*, Obs 2234/128, 09 Jul 2006; NMNZ P.042589 (154 mm HL, 605+ mm TL), South Georgia, 55° 12' S, 42° 15' W, 1430 m, FV *San Aspiring*, Obs 2234/228, 22 Aug 2006; NMNZ P.042590 (112 mm HL, 482+ mm TL), South Georgia, 53° 13' S, 42° 21' W, 1410 m, FV *San Aspiring*, Obs 2234/234, 25 Aug 2006; NMNZ P.045188 (185 mm HL, 810 mm TL), Pacific-Antarctic Ridge, 62° 31' S, 168° 28' E, 1180–1241 m, FV *San Aotea II*, Obs 2184/120, 13 Feb 2006.

Counts and measurements (Tables 1–2).

Description (Figures 8–9, Tables 1–2). Head large, length 3.6 to 4.7 into total length. Very strong scutes on head ridges, armed with strong spinules. Slightly elongated snout, length less than orbit diameter, tipped with a strong scute. Prominent strong scutes on angles of snout where nasal ridge meets suborbital ridge. Upper jaw about same length as orbit diameter, posterior end of premaxilla below or just behind mid-orbit. Chin barbel about one-third of orbit diameter.

Teeth in both jaws small, pointed. Upper jaw teeth in 4–5 rows with outer teeth not noticeably enlarged relative to those of inner rows. Lower jaw with 3–4 rows at tip, reducing to 2–3 posteriorly, outer teeth not noticeably enlarged.

Origins of pectoral and pelvic fins about on same vertical, and both slightly in advance of origin of first dorsal fin.

Body scales large, thick, adherent. Those between lateral line and first dorsal fin base with a long central row of enlarged strong spinules with 3–5 lateral ridges that lack spinules. Scales lateroventrally on body and tail with a central row of strong spinules. Dorsal head covered with heavy, spinulated, adherent scales, except for scaleless area around nostrils extending dorsally to nasal ridge and ventrally to suborbital ridge. Ventral surface of head entirely or mostly scaleless but up to 8 small patches of scales (usually less than about 10 small scales per patch) may be present at posterior end of head, beside articulation of lower jaw, beside posterior end of premaxilla, and rarely on posterior half of lower jaw.

Fresh colour of head and body dark brown. No obvious dark abdominal area in large individuals. Lining of mouth greyish-black and gill cavity blackish. Ventral surface of head dark greyish-brown. Fins greyish or blackish. Preserved specimens dark brownish.

Size. To at least 910 mm TL, and about 4.9 kg.

Distribution (Figure 5C). Probably widespread in temperate to Subantarctic waters of the southern hemisphere and northern Southern Ocean including the South Atlantic Ocean off the east coast of South America, South Georgia, Discovery Tablemount (Golovan & Pakhorukov, 1983; Trunov, 1986), southwest Pacific Ocean (Macquarie Ridge, Pacific-Antarctic Ridge), southeast Pacific Ocean off Chile (Ruiz R. & Oyarzun G., 1993), De Gerlache Seamount, at 850–2000 m. Two specimens captured on the north end of the Macquarie Ridge (NMNZ P.039949, P.039957) represent a new record of the species from the New Zealand EEZ.

Comparisons and remarks (Table 3). *Macrourus caml*, *M. carinatus*, and *M. whitsoni* all have a mostly scaled ventral surface of the head. *M. caml*, and *M. whitsoni* have much smaller body scales, 30–40 and 36–45 respectively in a diagonal row from anal fin origin to lateral line. *M. carinatus* has an outer row of enlarged teeth in the upper jaw and is generally pale to medium brown. *M. berglax* is known only from the northern hemisphere north of about 37° N, has pelvic fin with 8 (rarely 9) rays, large body scales with 13–17 diagonal rows from anal fin origin to lateral line, and 14–23 pyloric caeca.

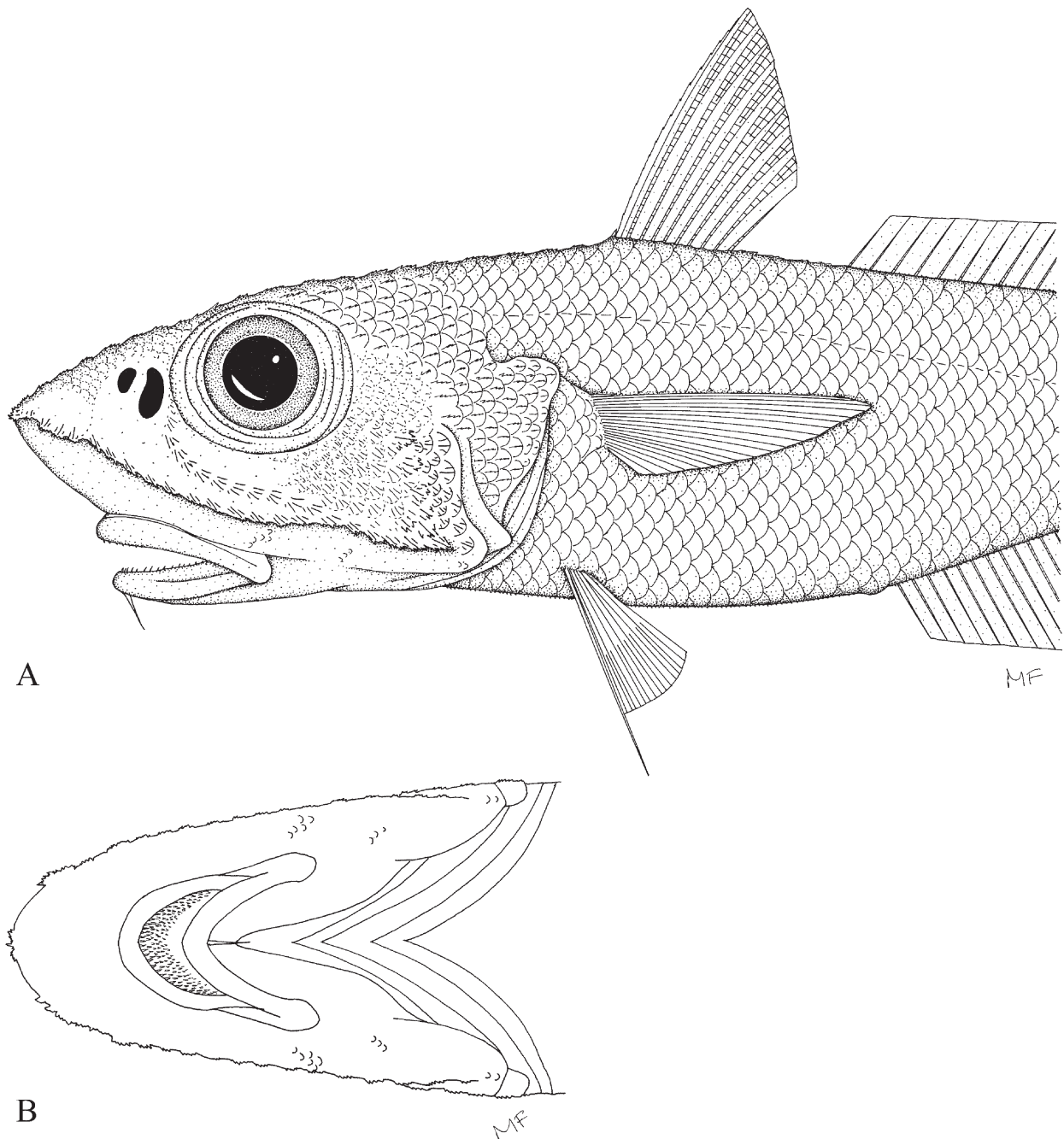


FIGURE 8. *Macrourus holotrachys*. NMNZ P.038598 (165 mm HL, 682 mm TL), Pacific-Antarctic Ridge, 63° 22.2' S, 175° 33.3' E, 1163–1166 m, 26 May 2002. (A) Lateral view of head and trunk; (B) ventral view of head and trunk, drawn by Michelle Freeborn (Te Papa).

***Macrourus whitsoni* (Regan 1913)**

Chalinura whitsoni Regan, 1913: 236, Pl. 2 [fig. 2]. 2 syntypes: 1—BMNH 1912.7.1.87, off Coats Land, Antarctica, 71°22' S, 16°34' W, 1410 fathoms [2578 m]; 2—NMSZ 1921.143.357 South Atlantic Ocean, 48°06' S, 10°05' W, depth 1742 fathoms [3186 m].

Macrourus whitsoni —Trunov & Konstantinov, 1989 (probably includes some *M. caml*, description, compared with *M. carinatus*, in Russian, English summary). Trunov & Konstantinov, 1990: 44–54 (described, illustrated, key, in Russian, English summary). Iwamoto in Cohen *et al.*, 1990: 233–240 (described, illustrated, key). Iwamoto in Gon & Heemstra, 1990: 192, 202–206 (described, illustrated, key).



A



B

FIGURE 9. *Macrourus holotrachys*. NMNZ P.038598 (165 mm HL, 682 mm TL), Pacific-Antarctic Ridge, 63° 22.2' S, 175° 33.3' E, 1163–1166 m, 26 May 2002. (A) Lateral view of head and trunk; (B) body scale between lateral line and first dorsal fin base, photos by Peter Marriott (NIWA).

Diagnosis. Ventral surface of the head mostly scaled, except for scaleless areas anterior to the mouth and on the anterior third of the lower jaw. Pelvic fin with 9 (rarely 10) rays. Lower jaw with a single row (sometimes 2 rows at tip) of long, slender, spaced (about a tooth-length) teeth. Upper jaw with 3–5 rows of teeth with teeth in the outer row enlarged relative to those of inner rows. Body scales relatively small, 36–45 in a diagonal row from anal fin origin to lateral line. Pyloric caeca 15–26.

Specimens examined. Syntype. **BMNH 1912.7.1.87** (63 mm HL, 274 mm TL), off Coats Land, 71° 22' S, 16° 34' W, 1410 fathoms (2578 m) *Scotia* stn. 417, trawl, 18 Mar 1904, here designated as the lectotype. The second syntype, **NMSZ 1921.143.357** (see Herman *et al.*, 1990), (approx. 420 mm TL) South Atlantic Ocean, 48° 6' S, 10° 5' W, 1742 fathoms (3186 m) was unavailable for study.

Non-type specimens (45). **NMNZ P.036149** (109 mm HL, 470 mm TL), Ross Sea slope, 77° 20' S, 169° 25' E, 780–848 m, FV *San Aotea* II, OBS 1180/028, bottom longline, 22 Jan 1999; **NMNZ P.036150** (2, 133–137 mm HL, 642–654 mm TL), Ross Sea slope, 73° 12' S, 177° 6' W, 978–1305 m, FV *Janas*, OBS 1181/028, bottom longline, 19 Jan 1999; **NMNZ P.037582** (3, 93–107 mm HL, 353–442 mm TL), Ross Sea slope, 72° 39' S, 179° 35' W, 76–2, 793 m, FV *Sonrisa*, OBS 1311/001, bottom longline, 30 Jan 2000; **NMNZ P.037797** (2, 97–109 mm HL,

435–517 mm TL), Ross Sea slope, 70° 55' S, 179° 13' E, 1217–1365 m, FV *San Aotea* II, OBS 1430/123, bottom longline, 25 Feb 2001; **NMNZ P.037807** (2, 95–109 mm HL, 396–423 mm TL), Ross Sea slope, 71° 28' S, 178° 10' W, FV *Sonrisa*, OBS 1431/10/R5C, bottom longline, 28 Jan 2001; **NMNZ P.038565** (100 mm HL, 456 mm TL), Scott Island, Ross Sea, 66° 29' S, 176° 30' W, 1179–1212 m, FV *San Aotea* II, OBS 1595B/150A, bottom longline, 23 Apr 2002; **NMNZ P.038619** (88 mm HL, 412 mm TL), Ross Sea slope, 75° 12' S, 174° 6' W, 1323–1368 m, FV *Janas*, OBS 1593A/060, bottom longline, 06 Feb 2002; **NMNZ P.039868** (79 mm HL, 338 mm TL), Balleny Islands, 67° 42' S, 167° 9' E, 1307–1340 m, FV *San Liberatore*, OBS 1743/031, bottom longline, 10 Mar 2003; **NMNZ P.039984** (79 mm HL, 338 mm TL), Pacific–Antarctic Ridge, 65° 15' S, 178° 10' W, 1445–1452 m, FV *Janas*, OBS 1728/077, bottom longline, 16 Feb 2003; **NMNZ P.039985** (81 mm HL, 256 mm TL), Pacific–Antarctic Ridge, 66° 40' S, 177° 26' W, 1160–1339 m, FV *Janas*, OBS 1728/020, bottom longline, 08 Jan 2003; **NMNZ P.039986** (74 mm HL, 330 mm TL), Pacific–Antarctic Ridge, 65° 25' S, 178° 18' W, FV *Janas*, OBS 1728/084, bottom longline, 20 Feb 2003; **NMNZ P.040622** (92 mm HL, 435 mm TL), Scott Canyon, Ross Sea, 72° 13' S, 175° 55' E, 1333–1382 m, FV *Gudni Olafsson*, OBS 1843/034, bottom longline, 20 Jan 2004; **NMNZ P.040623** (82 mm HL, 371 mm TL), Adare Seamounts, Ross Sea, 71° 27' S, 176° 47' E, 1200–1221 m, FV *Gudni Olafsson*, OBS 1843/042, bottom longline, 25 Jan 2004; **NMNZ P.041442** (149 mm HL, 657 mm TL), Ross Sea slope, 71° 20' S, 179° 18' W, 1315–1679 m, FV *San Aspiring*, OBS 2011/058, bottom longline, 23 Jan 2005; **NMNZ P.042295** (2, 115–119 mm HL, 525–530 mm TL), **NMNZ P.042316** (2, 117–122 mm HL, 542–588 mm TL) Off Wilkes Land, 64° 22' S, 114° 23' E, 1696–1738 m, FV *San Aspiring*, OBS 2183/093, bottom longline, 15 Feb 2006; **NMNZ P.043665** (109 mm HL, 512 mm TL), Ross Sea slope, 72° 5' S, 175° 35' E, 1567–1587 m, RV *Tangaroa*, IPY/CAML TAN 0802/133, bottom trawl, 22 Feb 2008; **43732** (125 mm HL, 592 mm TL), **NMNZ P.043733** (118 mm HL, 545 mm TL), **NMNZ P.043734** (113 mm HL, 573 mm TL), **NMNZ P.043735** (131 mm HL, 607 mm TL), **NMNZ P.043736** (106 mm HL, 500 mm TL), **NMNZ P.043737** (10, 46–73 mm HL, 204–334 mm TL) Ross Sea slope, 71° 52' S, 174° 4' E, 1954–1990 m, RV *Tangaroa*, IPY/CAML TAN 0802/167, bottom trawl, 25 Feb 2008; **NMNZ P.043855** (67 mm HL, 281 mm TL), North Scott Seamounts, 68° 7' S, 179° 15' W, 855–879 m, RV *Tangaroa*, IPY/CAML TAN 0802/211, bottom trawl, 03 Mar 2008; **NMNZ P.051973** (90 mm HL, 387 mm TL), Ross Sea slope, 69° 21' S, 178° 39' W, 425–1661 m, FV *Janas*, OBS 1429/122, bottom longline, 20 Feb 2001; **NMNZ P.051974** (104 mm HL, 452 mm TL), **NMNZ P.051975** (2, 115–124 mm HL, 520–546 mm TL) Cosmonaut Sea, 66° 19' S, 33° 14' E, 1317–1334 m, FV *Janas*, OBS 2068/033, bottom longline, 26 Mar 2005; **NMNZ P.051987** (125 mm HL, 578 mm TL), Ross Sea slope, 73° 15' S, 177° 18' W, 940–1211 m, FV *Janas*, OBS 1181/027, bottom longline, 19 Jan 1999.

Counts and measurements (Tables 1–2).

Description (Figures 10–11, Tables 1–2). Head large, length 3.2 to 5.1 into total length. Small scutes on head ridges, armed with short spinules. Slightly pointed snout, length less than orbit diameter, tipped with a prominent scute. Upper jaw larger than orbit diameter, posterior end of premaxilla below about rear of orbit. Chin barbel about one third of orbit diameter.

Teeth in both jaws pointed, may be slightly curved inwards. Upper jaw teeth in up to 4–5 rows at tip but 2 rows posteriorly with outer teeth noticeably enlarged. Lower jaw with long, slender, spaced (about a tooth-length) teeth in 1–2 rows at tip, usually 1 row posteriorly.

Origins of pectoral and pelvic fins about on same vertical, and both slightly in advance of origin of first dorsal fin. Pelvic fin relatively long compared to others in genus.

Body scales small, deciduous. Those between lateral line and first dorsal fin base with a central row of small spinules and there may be one short row of small spinules on each side. Body scales on lower body lack a central spinule row. Dorsal head covered with small, flat, adherent scales, except for scaleless area around nostrils extending dorsally to nasal ridge but usually a few scales ventrally above suborbital ridge. Ventral surface of head anterior to mouth scaleless. Numerous rows of small flat scales lacking spinules at posterior end of ventral surface of head. Scales extending forward to about level with nostrils and reducing to a few rows anteriorly. Small scales on rear half to two-thirds of lower jaw.

Fresh colour of head and body pale to medium brownish, pale in smaller specimens. Sides of head and abdomen may be silvery to whitish under the scales. Lining of mouth, gill cavity, and lips greyish–black. Ventral surface of head brownish with numerous pale pore openings. Fins pale greyish–brown. Preserved specimens brownish overall.

Size. To about 660 mm TL. This appears to be the smallest species in the genus.

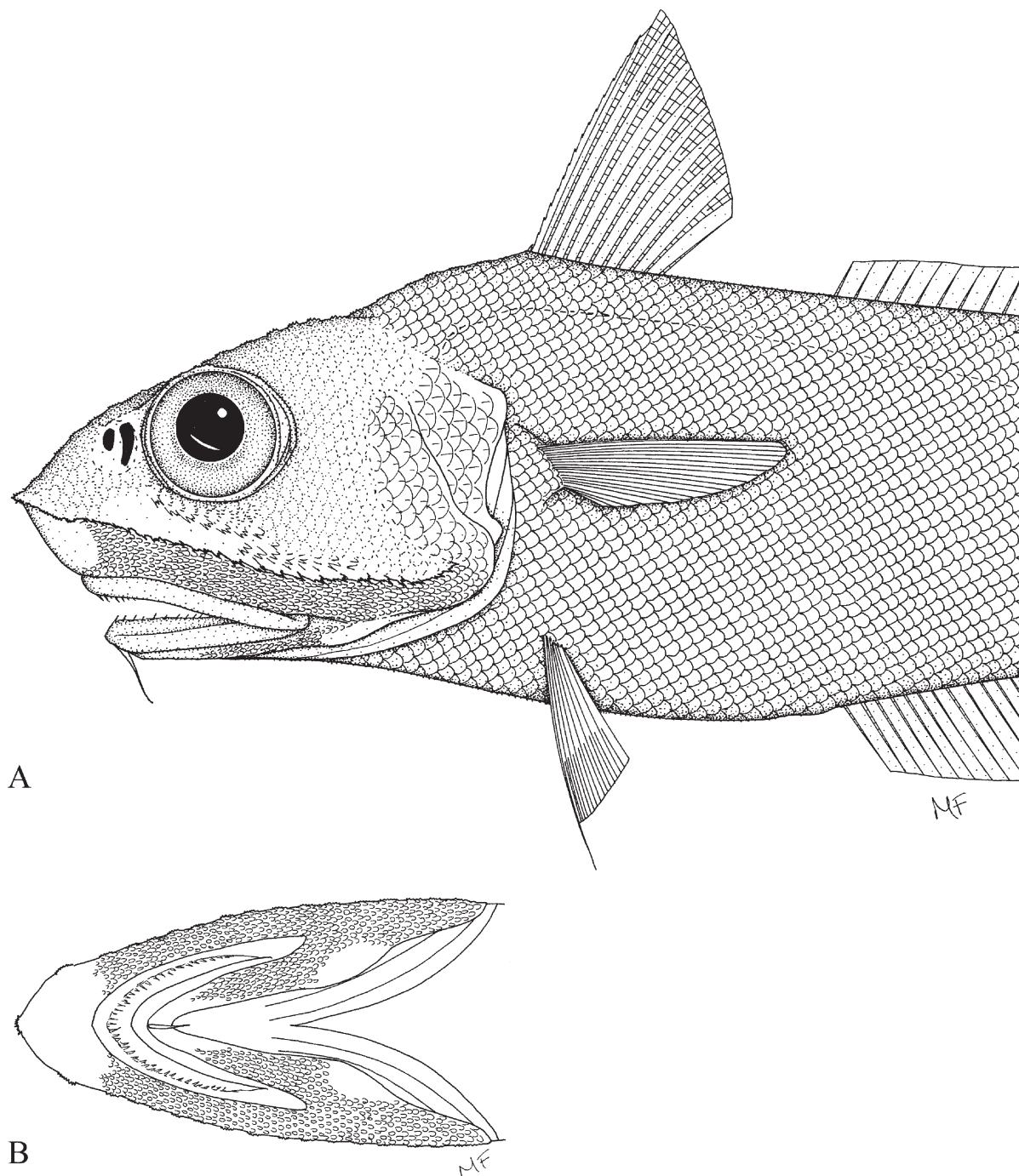


FIGURE 10. *Macrourus whitsoni*. NMNZ P.042316 (122 mm HL, 588 mm TL) Durmont D'Urville Sea, off Wilkes Land, Antarctica, 64° 22' S, 114° 23' E, 1696–1738 m, 15 Feb 2006. (A) Lateral view of head and trunk; (B) ventral view of head and trunk, drawn by Michelle Freeborn (Te Papa).

Distribution (Figure 5D). Probably widespread in the Southern Ocean. Specimens examined in this study were from 64–77° S from the South Atlantic Ocean off Coats Land, south Indian Ocean (Cosmonaut Sea, Durmont D'Urville Sea), and South Pacific Ocean (Ross Sea, Balleny and Scott Islands slope, Pacific Antarctic Ridge), at 400–3200 m. The lectotype and paralectotype are the deepest records of the species (2579 and 3186 m respectively).

Comparisons and remarks (Table 3). *Macrourus caml* has 8 (rarely 7 or 9) pelvic fin rays, a band (2–3 rows) of small uniform-sized teeth in the lower jaw, lacks an outer row of enlarged teeth in the upper jaw, and 30–40

scales in a diagonal row from anal fin origin to lateral line. *M. carinatus* has large body scales with 19–25 in a diagonal row from anal fin origin to lateral line. *Macrourus holotrachys* (southern hemisphere) and *M. berglax* (northern hemisphere) both have an almost scaleless ventral surface of the head. See “Comparisons and remarks” for *M. caml* for comments about Trunov & Konstantinov (1989) work on *M. whitsoni*.

The paralectotype (NMSZ 1921.143.357) was unavailable for study and its identity is uncertain. In the description, Regan (1913) states that the pelvic fin is “9-rayed”, and that the macrourid genera included in the paper had “teeth in the lower jaw uniserial”. Both these characters suggest that the specimen is conspecific with the lectotype but doubt remains because the paralectotype is the northernmost (48° 6' S, Mid-Atlantic Ridge south of Gough Island) and deepest (3186 m) record compared to the specimens of *Macrourus whitsoni* examined in this study (Fig. 5D).



A



B

FIGURE 11. *Macrourus whitsoni*. (A) NMNZ P.036149 (109 mm HL, 470+ mm TL) Ross Sea slope, Antarctica, 77° 20.1' S, 169° 2.2' E, 780–848 m, 22 Jan 1999, photo by Andrew Stewart (NMNZ). (B) NMNZ P.051987 (125 mm HL, 578 mm TL), Ross Sea slope, 73° 14.7' S, 177° 18.3' W, 940–1211 m, 19 Jan 1999, body scale between lateral line and first dorsal fin base, photo by Peter Marriott (NIWA).

Key to species of *Macrourus*

1. Underside of head without scales or with up to 8 small patches of scales (usually less than 10 small scales per patch) adjacent to angles of the mouth and at posterior of head, rarely any scales on lower jaw (Fig. 12) 2
- Underside of head with scales present in rows (not just small patches) extending forward from posterior part of head to below anterior margin of orbit or nostrils between suborbital ridge and mouth, and scales on base of lower jaw (Fig. 13) 3

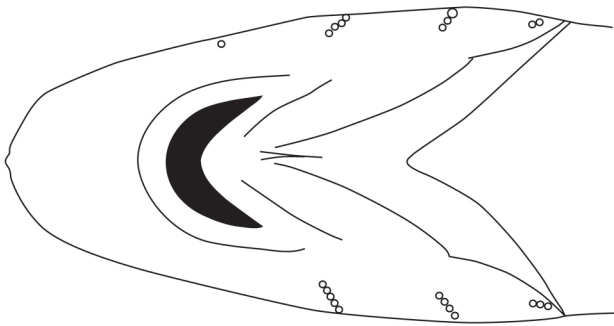


FIGURE 12.

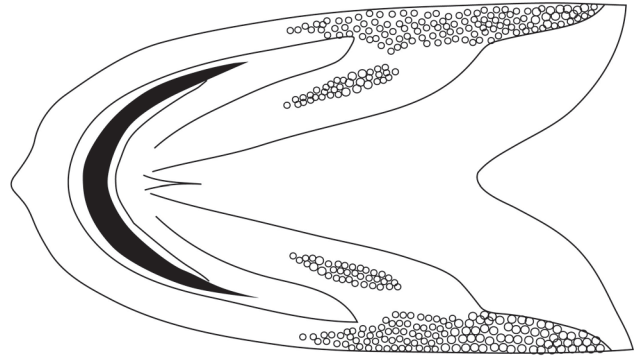


FIGURE 13.

2. Pelvic fin rays 8 or 9 (rarely 10), pyloric caeca 9–16, recorded only from the South Atlantic and South Pacific Oceans from about 37° S southward. *M. holotrachys*
- Pelvic fin rays 8 (rarely 9), pyloric caeca 14–23, recorded only from the North Atlantic Ocean from about 37° N northward *M. berglax*
3. Pelvic fin rays 8 (rarely 7 or 9), lower jaw with 2–5 rows of small uniform-sized, closely spaced teeth (Fig. 14) 4
- Pelvic fin rays 9 (rarely 10), lower jaw with a single row (may be 2 rows at tip of jaw) of slender, slightly elongated, spaced (about 1 tooth-length apart) teeth (Fig. 15) *M. whitsoni*

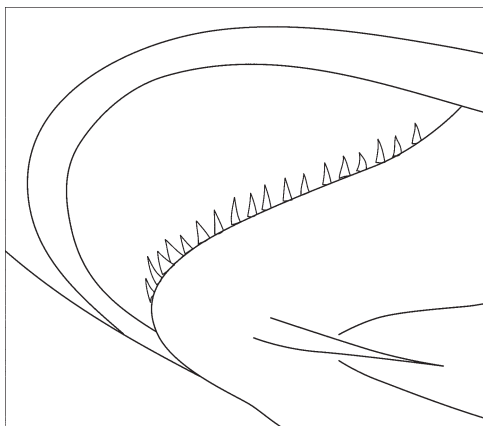


FIGURE 14.



FIGURE 15.

4. Outer row of teeth in upper jaw slightly enlarged, large body scales with 19–25 in a diagonal row from anal fin origin forward to (not including) lateral line (Fig. 16), widespread in temperate, Subantarctic southern hemisphere, and northern Southern Ocean. *M. carinatus*
- Teeth in upper jaw uniform-sized, small body scales with 30–40 in a diagonal row from anal fin origin forward to (not including) lateral line, widespread in Southern Ocean *Macrourus caml* sp. nov.

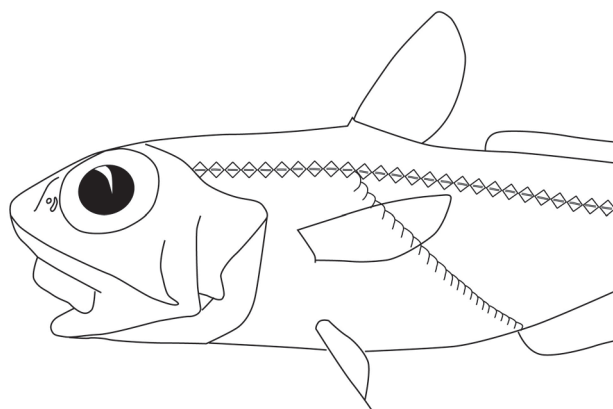


FIGURE 16.

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